# Linear Relationships

Curriculum Ready

Mathletics

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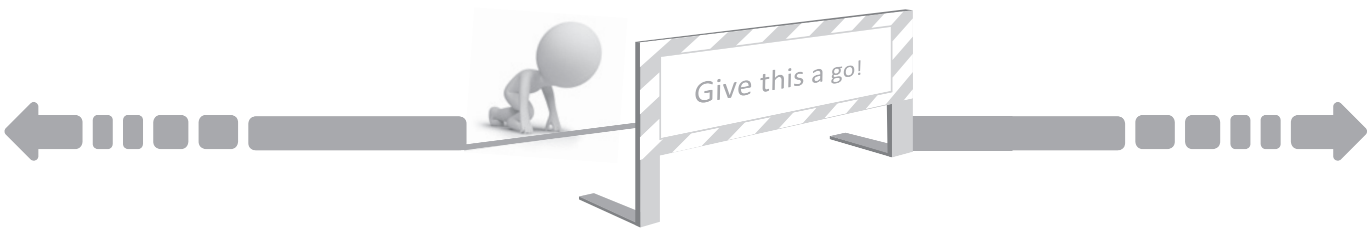
This booklet extends on straight line concepts by investigating the relationship between points on a line

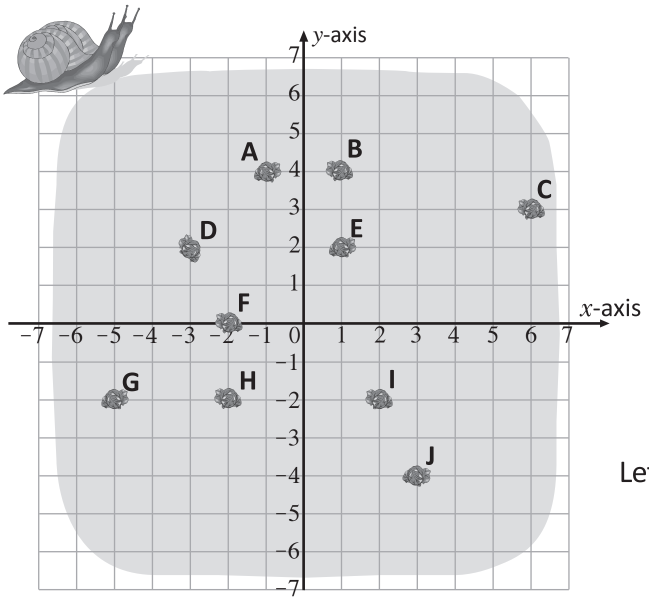
Write a single sentence that describes the mathematical meaning for these terms:
You can use a small diagram/example to support your description.

| **Continuous** | **Linear** | **Relationship** |
|---|---|---|
| | | |

Join these definitions together to describe in a one sentence what you think is meant by a **linear relationship**.




**Q** Two snails have spotted the best lettuce in the garden and are travelling in straight lines towards it for dinner.
Slidy Sam is following the path: $y = 2 - 2x$ and Slippery Shelly is following the path: $2y = -x - 2$
Which lettuce are they both moving towards if it is at the point where their paths cross?




Lettuce Sam and Shelly are moving towards:

Work through the book for a great way to solve this

## Gradient-intercept form

A linear relationship is an algebraic rule that forms a continuous, straight line when graphed.
Let's review the basic **linear equation**.

the power of $x$ and $y$ is always $1$

gradient-intercept form $\longrightarrow$ $\boldsymbol{y = mx + b}$

coefficient of $x$ ($m$) is the gradient

the constant term ($b$) is the $y$-intercept

Before graphing it is important to be able to extract the correct information from a linear equation.

For the equation $y = 3x - 4$

(i) Write the gradient and $y$-intercept for the graph of $y = 3x - 4$

$$y = 3x - 4$$

gradient $(m) = 3 = \frac{+3}{+1}$

$y$-intercept $(b) = -4$

(ii) Describe what these values mean for the graph of $y = 3x - 4$

$m = 3$: graph moves $+3$ vertically (slopes up) for every $+1$ horizontally

$b = -4$: graph passes through the point $(0, -4)$

or

the graph crosses the $y$-axis at $-4$

Equation is another word for rule

Sometimes the information needed can appear to be 'hidden'.

For the equation $y = x + 2$

(i) Write the gradient and $y$-intercept for the graph of $y = x + 2$

$$y = x + 2$$

gradient $(m) = 1 = \frac{+1}{+1}$

$y$-intercept $(b) = +2$

The $1$ in front of the $x$ is hidden

(ii) Describe what these values mean for the graph of $y = x + 2$

$m = 1$: graph moves $+1$ vertically (slopes up) for every $+1$ horizontally

$b = +2$: graph passes through the point $(0, 2)$

or

the graph crosses the $y$-axis at $2$

Here are some more examples with different points to look out for.

For the equation $y = \frac{2}{3}x + 1$

(i) Write the gradient and $y$-intercept for the graph of $y = \frac{2}{3}x + 1$

$$y = \frac{2}{3}x + 1$$

gradient $(m) = \frac{2}{3} = \frac{+2}{+3}$ $\qquad$ $y$-intercept $(b) = +1$

(ii) Describe what these values mean for the graph of $y = \frac{2}{3}x + 1$

$m = \frac{2}{3}$: graph moves $+2$ vertically (slopes up) for every $+3$ horizontally

$b = +1$: graph passes through the point $(0, 1)$ or the graph crosses the $y$-axis at $1$

Be careful to correctly interpret the meaning of negative signs.

For the equation $y = -4x + 5$

(i) Write the gradient and $y$-intercept for the graph of $y = -4x + 5$

$$y = -4x + 5$$

gradient $(m) = -4 = \frac{-4}{+1}$ $\qquad$ $y$-intercept $(b) = +5$

(ii) Describe what these values mean for the graph of $y = -4x + 5$

$m = 4$: graph moves $-4$ vertically (slopes down) for every $+1$ horizontally

$b = +5$: graph passes through the point $(0, 5)$ or the graph crosses the $y$-axis at $5$

When the coefficient of $x$ is a fraction, it can appear in a slightly different form.

Write the gradient and $y$-intercept for the graph of $y = -\frac{x}{3} + \frac{1}{2}$

$y = -\frac{x}{3} + \frac{1}{2}$ or $y = -\frac{1}{3}x + \frac{1}{2}$

gradient $(m) = -\frac{1}{3} = \frac{-1}{+3}$ $\qquad$ $y$-intercept $(b) = \frac{1}{2}$

Don't let expressions written in a different order trick you.

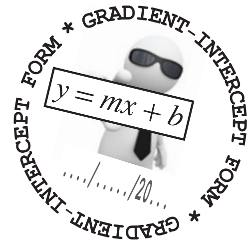
Write the gradient and $y$-intercept for the graph of $y = 3 - 2x$

Remember:
The coefficient is the number in front of the variable

$y = 3 - 2x$ $\qquad$ same as $y = -2x + 3$

$y$-intercept $(b) = +3$ $\qquad$ gradient $(m) = -2 = \frac{-2}{+1}$

## Gradient-intercept form




**1** (i) Write the gradient and $y$-intercept for each of these linear equations
(ii) Describe what these values mean for the graph of each linear equation

**a** $y = 2x - 1$

(i) Gradient ($m$) = ☐

$y$-intercept ($b$) = ☐

(ii) The graph of $y = 2x - 1$ moves:

☐ vertically for every ☐ horizontally

**b** $y = x - 6$

(i) Gradient ($m$) = ☐

$y$-intercept ($b$) = ☐

(ii) The graph of $y = x - 6$ moves:

☐ vertically for every ☐ horizontally

**c** $y = -3x + 2$

(i) Gradient ($m$) = ☐

$y$-intercept ($b$) = ☐

(ii) The graph of $y = -3x + 2$ moves:

☐ vertically for every ☐ horizontally

**d** $y = 5x + 2$

(i) Gradient ($m$) = ☐

$y$-intercept ($b$) = ☐

(ii) The graph of $y = 5x + 2$ moves:

☐ vertically for every ☐ horizontally

**e** $y = -x + 6$

(i) Gradient ($m$) = ☐

$y$-intercept ($b$) = ☐

(ii) The graph of $y = -x + 6$ moves:

☐ vertically for every ☐ horizontally

**f** $y = -3x + \frac{1}{4}$

(i) Gradient ($m$) = ☐

$y$-intercept ($b$) = ☐

(ii) The graph of $y = -3x + \frac{1}{4}$ moves:

☐ vertically for every ☐ horizontally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## Gradient-intercept form

**1** (i) Write the gradient and $y$-intercept for each of these linear equations
(ii) Describe what these values mean for the graph of each linear equation

**a** $y = 2 + x$

(i) Gradient ($m$) = ______

$y$-intercept ($b$) = ______

(ii) The graph of $y = 2 + x$ moves:

______ vertically for every ______ horizontally

**b** $y = \frac{1}{2}x + \frac{2}{3}$

(i) Gradient ($m$) = ______

$y$-intercept ($b$) = ______

(ii) The graph of $y = \frac{1}{2}x + \frac{2}{3}$ moves:

______ vertically for every ______ horizontally

**c** $y = -3x$

(i) Gradient ($m$) = ______

$y$-intercept ($b$) = ______

(ii) The graph of $y = -3x$ moves:

______ vertically for every ______ horizontally

**d** $y = -\frac{x}{2} + 8$

(i) Gradient ($m$) = ______

$y$-intercept ($b$) = ______

(ii) The graph of $y = -\frac{x}{2} + 8$ moves:

______ vertically for every ______ horizontally

**e** $y = \frac{-1}{3} - x$

(i) Gradient ($m$) = ______

$y$-intercept ($b$) = ______

(ii) The graph of $y = \frac{-1}{3} - x$ moves:

______ vertically for every ______ horizontally

**f** $y = \frac{4}{5} - \frac{3x}{2}$

(i) Gradient ($m$) = ______

$y$-intercept ($b$) = ______

(ii) The graph of $y = \frac{4}{5} - \frac{3x}{2}$ moves:

______ vertically for every ______ horizontally

## Rearranging linear relationships

Some linear relationships need to be re-arranged before the gradient and $y$-intercept can be read.

Using a similar method to solving equations, make $y$ the subject of the formula.

**Write the gradient and $y$-intercept for the graph of $2y - 6x = 12$**

$$2y - 6x = 12$$ move $6x$ over to the right hand side

$$+6x \quad +6x$$

$$2y = 6x + 12$$ divide every term by $2$ to isolate $y$

$$\div 2 \quad \div 2 \quad \div 2$$

$$y = 3x + 6$$ linear equation is now in the form $y = mx + b$

gradient $(m) = 3 = \frac{+3}{+1}$ $y$-intercept $(b) = +6$

Leave values as simplified fractions after rearranging.

**Write the gradient and $y$-intercept for the graph of $2x + 3y = 9$**

$$2x + 3y = 9$$ move $2x$ over to the right hand side

$$-2x \quad -2x$$

$$3y = 9 - 2x$$ divide every term by $3$ to isolate $y$

$$\div 3 \quad \div 3 \quad \div 3$$

$$y = 3 - \frac{2}{3}x$$

$$y = -\frac{2}{3}x + 3$$ linear equation is now in the form $y = mx + b$

gradient $(m) = -\frac{2}{3} = \frac{-2}{+3}$ $y$-intercept $(b) = +3$

Here is another example where a $1$ is hidden at the end.

**Write the gradient and $y$-intercept for the graph of $\frac{3y - x}{9} = 2$**

$$\frac{3y - x}{9} \times 9 = 2 \times 9$$ multiply both side by $9$

$$3y - x = 18$$ move $x$ over to the right hand side

$$+x \quad +x$$

$$3y = x + 18$$ divide every term by $3$ to isolate $y$

$$\div 3 \quad \div 3 \quad \div 3$$

$$y = \frac{x}{3} + 6$$

gradient $(m) = \frac{1}{3} = \frac{+1}{+3}$ $y$-intercept $(b) = +6$

## Rearranging linear relationships

**1** (i) Rearrange each of these linear relationships into gradient-intercept form ($y = mx + b$)
(ii) Write the gradient and $y$-intercept for each of these linear equations

**a** $4y = 8x - 12$

(i)

(ii) Gradient ($m$) =

$y$-intercept ($b$) =

**b** $2y = 14x + 6$

(i)

(ii) Gradient ($m$) =

$y$-intercept ($b$) =

**c** $10y - 10x = 25$

(i)

(ii) Gradient ($m$) =

$y$-intercept ($b$) =

**d** $4y + 3x = 12$

(i)

(ii) Gradient ($m$) =

$y$-intercept ($b$) =

**e** $6x + 2y = 1$

(i)

(ii) Gradient ($m$) =

$y$-intercept ($b$) =

**f** $8x - 4y = 16$

hint: be careful with negative values here

(i)

(ii) Gradient ($m$) =

$y$-intercept ($b$) =

## Rearranging linear relationships

**2** (i) Rearrange each of these linear relationships into gradient-intercept form $(y = mx + b)$
(ii) Write the gradient and $y$-intercept for each of these linear equations

**a** $\frac{y}{3} = x - 1$

(i)

(ii) Gradient ($m$) = 

$y$-intercept ($b$) = 

**b** $\frac{1}{2}y = 2x + 3$

(i)

(ii) Gradient ($m$) = 

$y$-intercept ($b$) = 

**c** $\frac{y - x}{3} = 2$

(i)

(ii) Gradient ($m$) = 

$y$-intercept ($b$) = 

**d** $\frac{2y + 6x}{5} = 6$

(i)

(ii) Gradient ($m$) = 

$y$-intercept ($b$) = 

**e** $\frac{5y + 4x}{2} = 1$

(i)

(ii) Gradient ($m$) = 

$y$-intercept ($b$) = 

**f** $5y + 3x = \frac{5}{3}$

hint: be careful with the sign of the gradient

(i)

(ii) Gradient ($m$) = 

$y$-intercept ($b$) = 

## Graphing using the intercept and gradient

After first plotting the $y$-intercept, the gradient can then be used to find a second point to help draw the graph.

For the equation $y = x + 2$

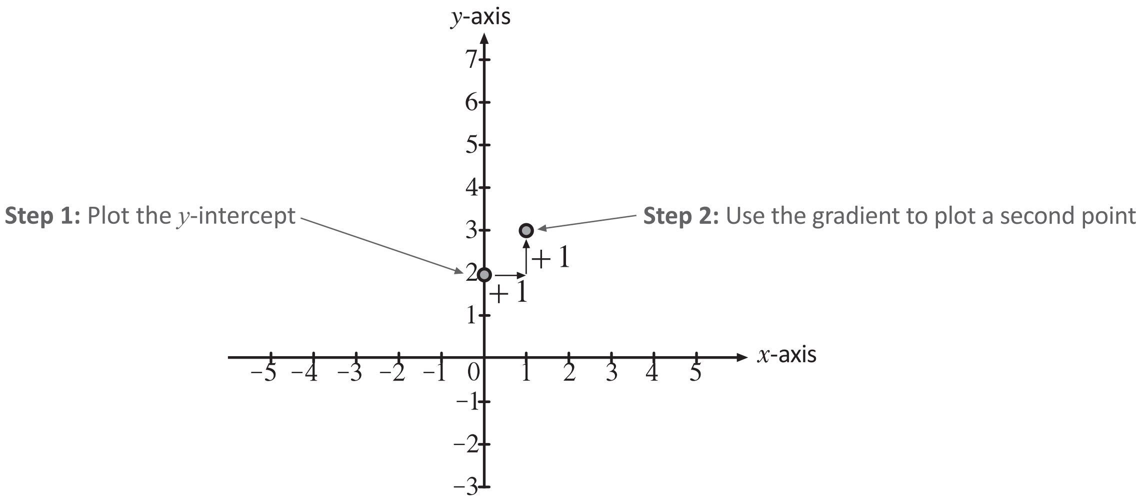
(i) Write the gradient and $y$-intercept for the graph of $y = x + 2$

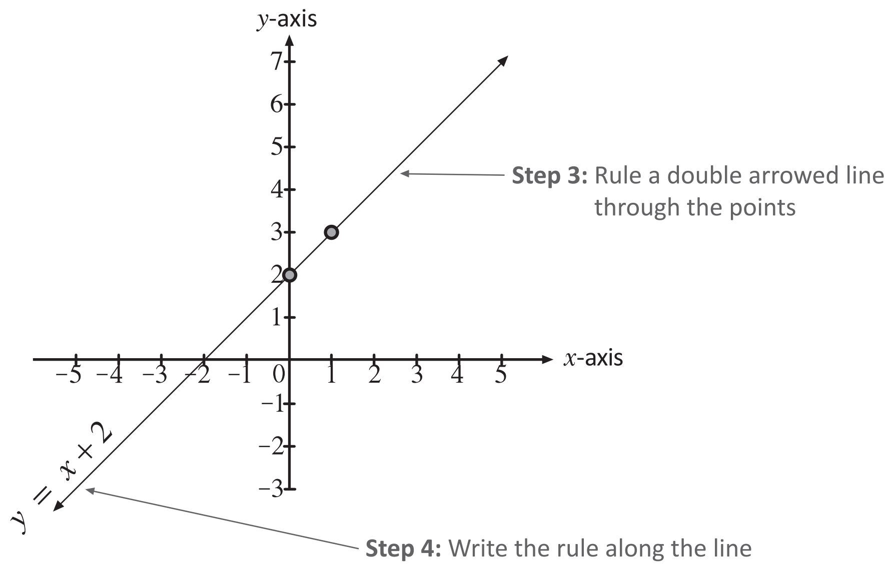
$$y = x + 2$$

gradient $(m) = 1 = \dfrac{+1}{+1}$ $y$-intercept $(b) = +2$

$\therefore$ Graph of the rule moves $+1$ vertically (slopes up) for every $+1$ horizontally and passes through the $y$-axis at $(0\ ,\ 2)$

(ii) Describe what these values mean for the graph of $y = x + 2$



Rearrange linear relationships first to find the $y$-intercept and gradient.

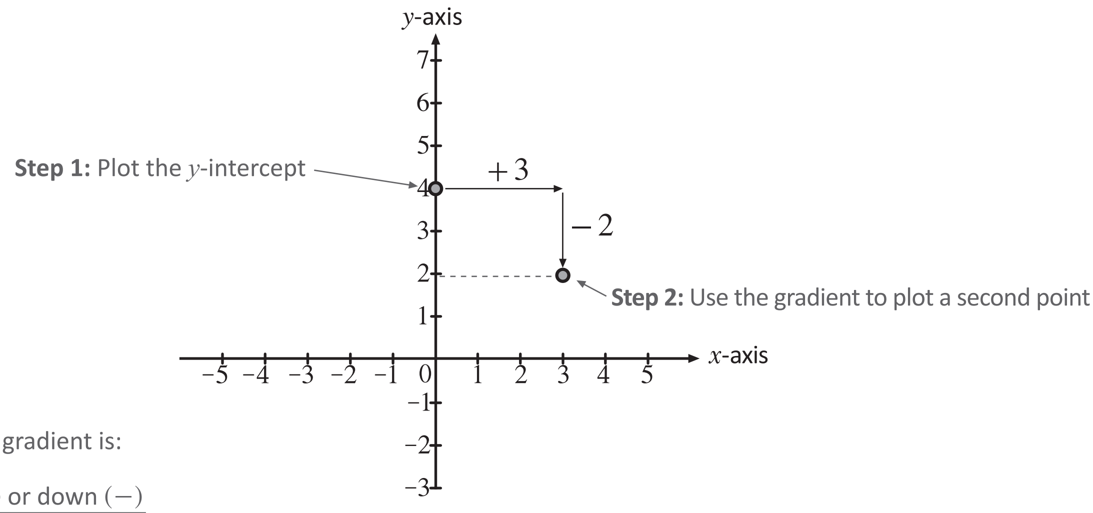
For the equation $3y + 2x = 12$

(i) Write the gradient and $y$-intercept for the graph of $3y + 2x = 12$

$$\begin{aligned} 3y + 2x &= 12 && \text{move } 2x \text{ over to the right hand side} \\ -2x \quad & \quad -2x \\ 3y &= 12 - 2x && \text{divide every term by 3 to isolate } y \\ \div 3 \quad & \quad \div 3 \quad \div 3 \\ y &= 4 - \frac{2}{3}x \\ y &= -\frac{2}{3}x + 4 && \text{linear equation is now in the form } y = mx + b \end{aligned}$$

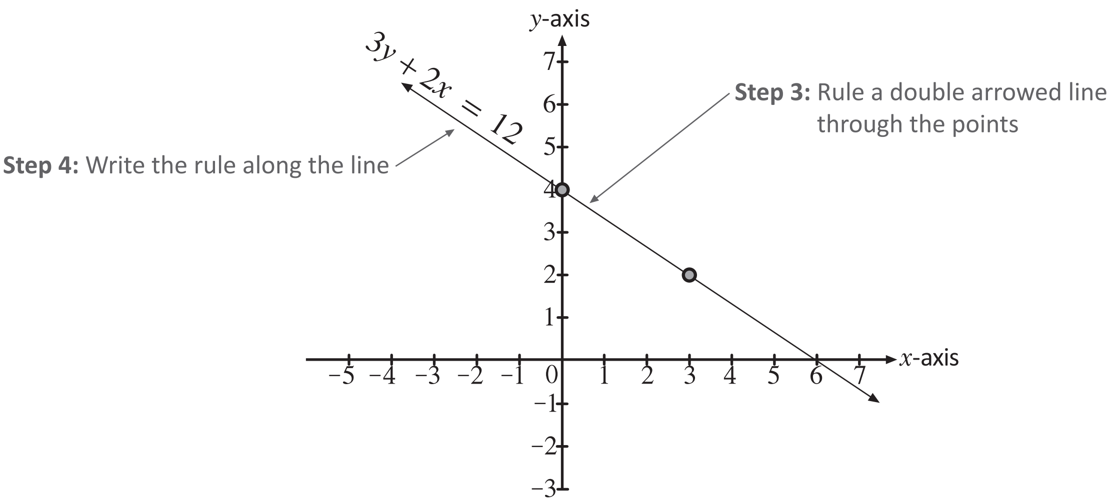
gradient $(m) = -\frac{2}{3} = \frac{-2}{+3}$ $y$-intercept $(b) = +4$

(ii) Use this information to graph the linear equation $3y + 2x = 12$

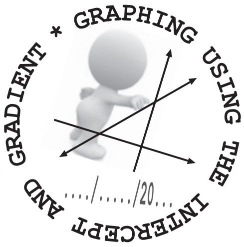



Remember the gradient is:

$\frac{\text{How far up } (+) \text{ or down } (-)}{\text{How far across } (+)}$



## Graphing using the intercept and gradient

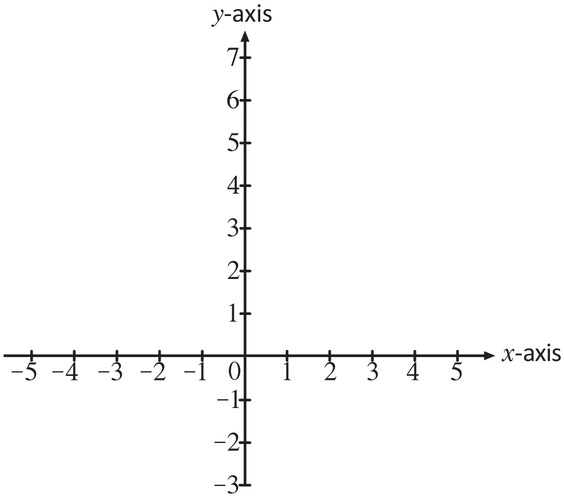



**1** Sketch each of these linear equations using the $y$-intercept and gradient

**a** $y = 2x + 3$

Gradient ($m$) =

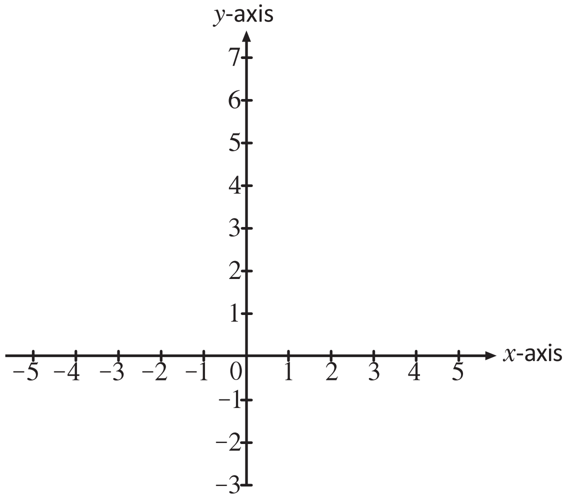
$y$-intercept ($b$) =




**b** $y = -3x + 1$

Gradient ($m$) =

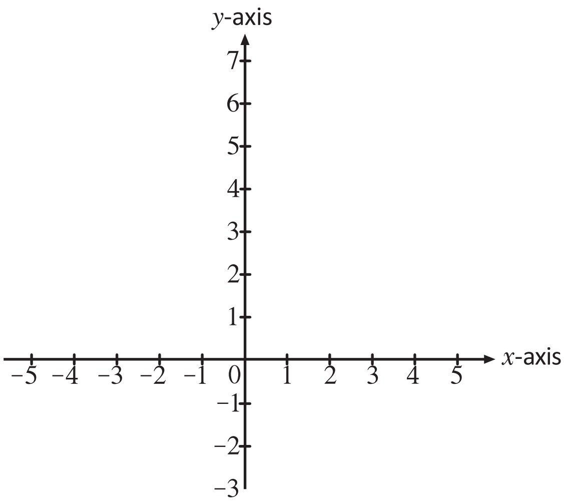
$y$-intercept ($b$) =




**c** $y = \frac{1}{2}x + 3$

Gradient ($m$) =

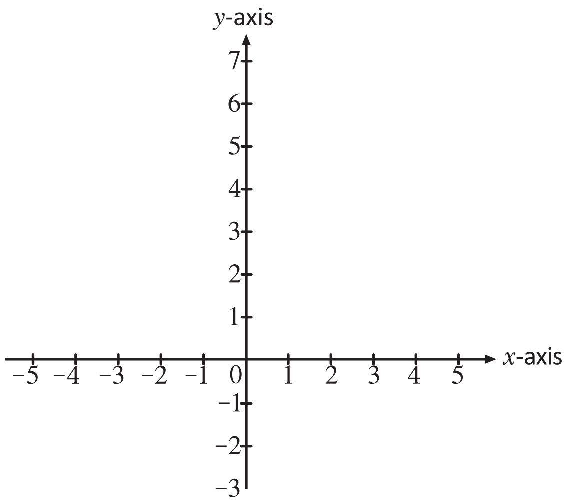
$y$-intercept ($b$) =




**d** $y = \frac{2}{5}x + 2$

Gradient ($m$) =

$y$-intercept ($b$) =



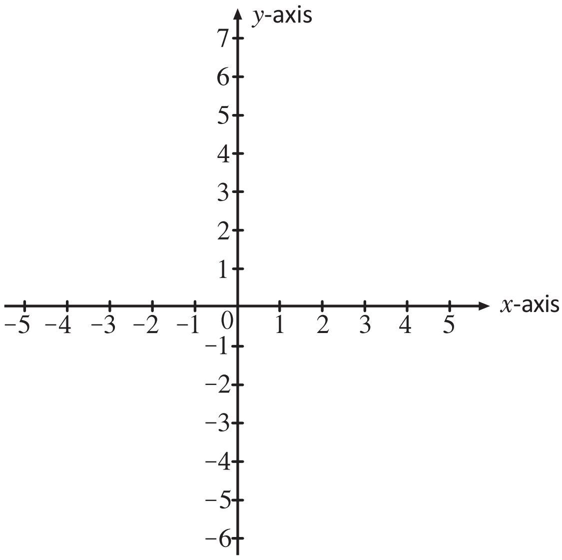
## Graphing using the intercept and gradient

2 Sketch each of these linear equations using the $y$-intercept and gradient

a $y = -2x - 4$

Gradient ($m$) =

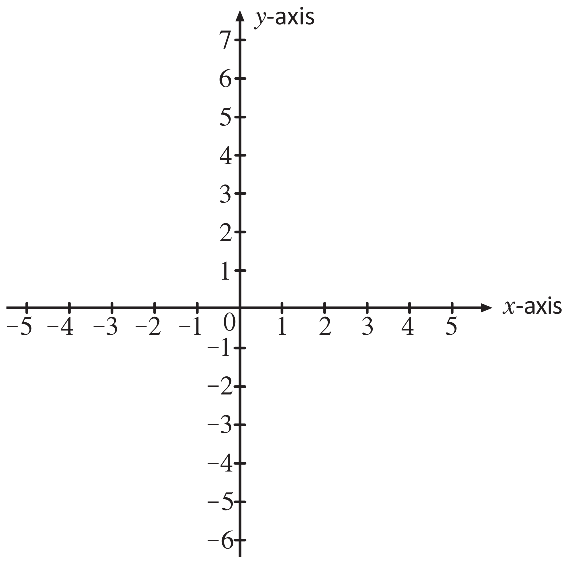
$y$-intercept ($b$) =




b $y = -x - 5$

Gradient ($m$) =

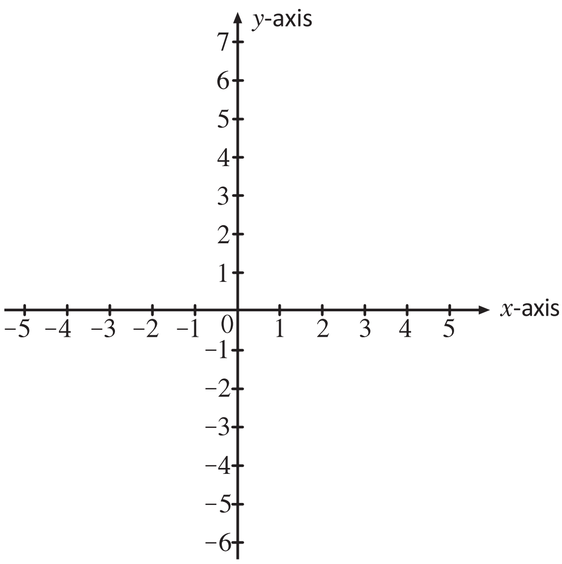
$y$-intercept ($b$) =




c $y = \frac{3}{5}x - 3$

Gradient ($m$) =

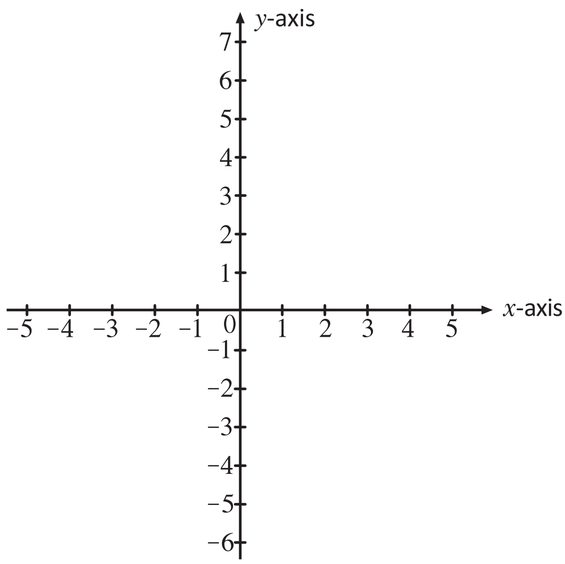
$y$-intercept ($b$) =




d $y = -\frac{5}{3}x$

Gradient ($m$) =

$y$-intercept ($b$) =





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## Graphing using the intercept and gradient

**3** (i) Write the gradient and $y$-intercept for each of these linear equations
(ii) Use this information to graph each linear equation

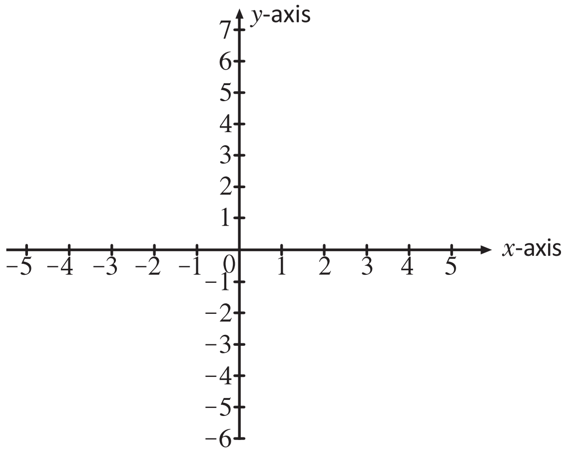
**a** $4y - 3x = -4$

(i)

Gradient ($m$) = 

$y$-intercept ($b$) = 

(ii)



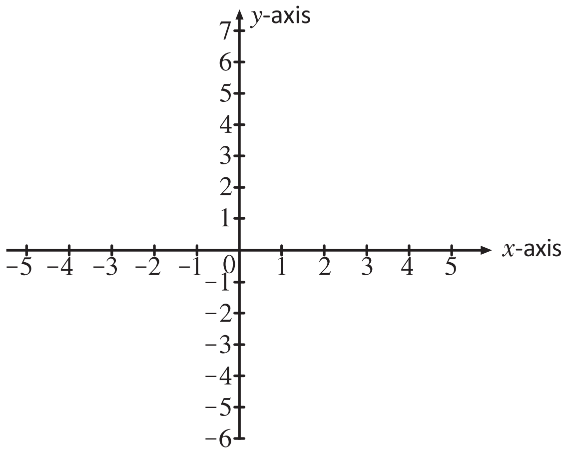

**b** $\dfrac{3y + 2x}{3} = 1$

(i)

Gradient ($m$) = 

$y$-intercept ($b$) = 

(ii)



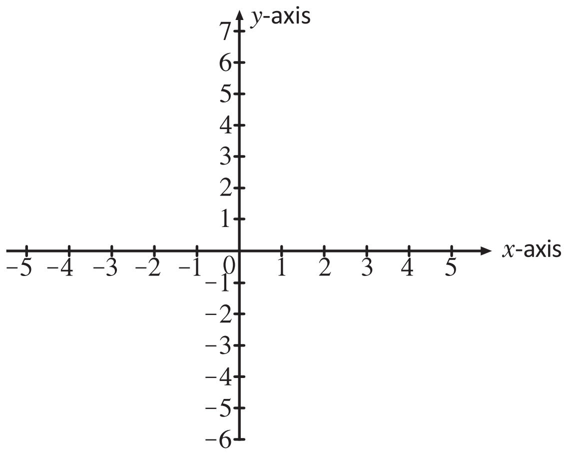

**c** $2x + 3y = \dfrac{9}{2}$

(i)

Gradient ($m$) = 

$y$-intercept ($b$) = 

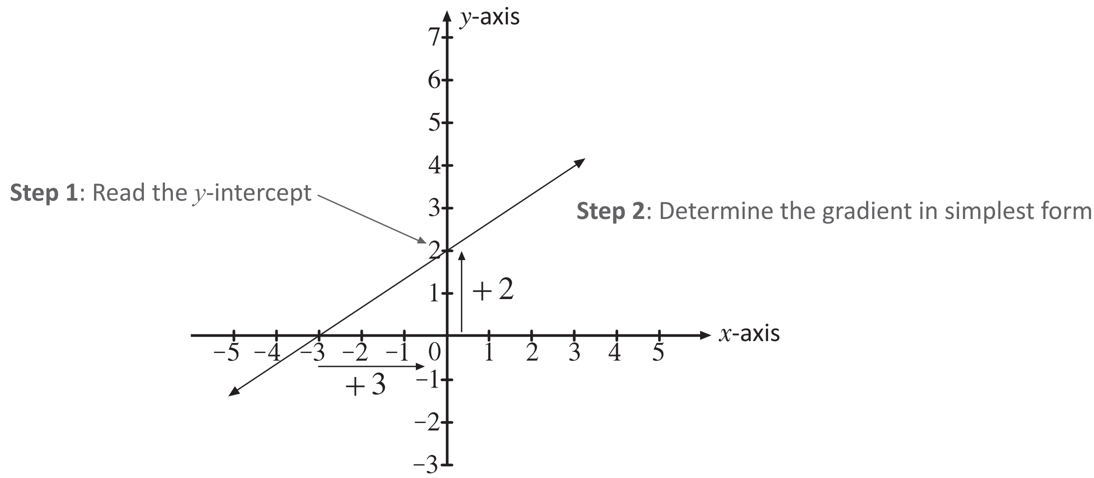
(ii)



## The linear equation from the graph

By working in **reverse** to before, we can find the $y$-intercept and gradient of the line.
These values are then substituted into the gradient-intercept formula.

Find the equation of the line for the linear graph below:



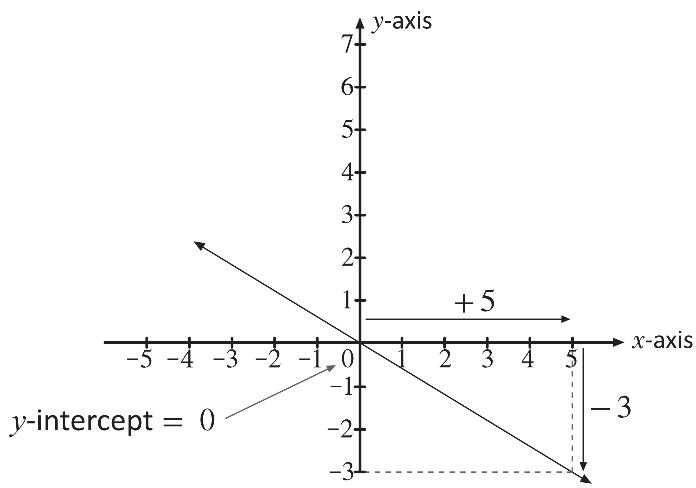

$y$-intercept $(b) = +2$

Gradient $(m) = \frac{+2}{+3} = \frac{2}{3}$

$$y = mx + b$$
$$\therefore y = \frac{2}{3}x + 2$$

For graphs with only one visible intercept, search for another easy-to-read point.

Find the equation of the line for this linear graph



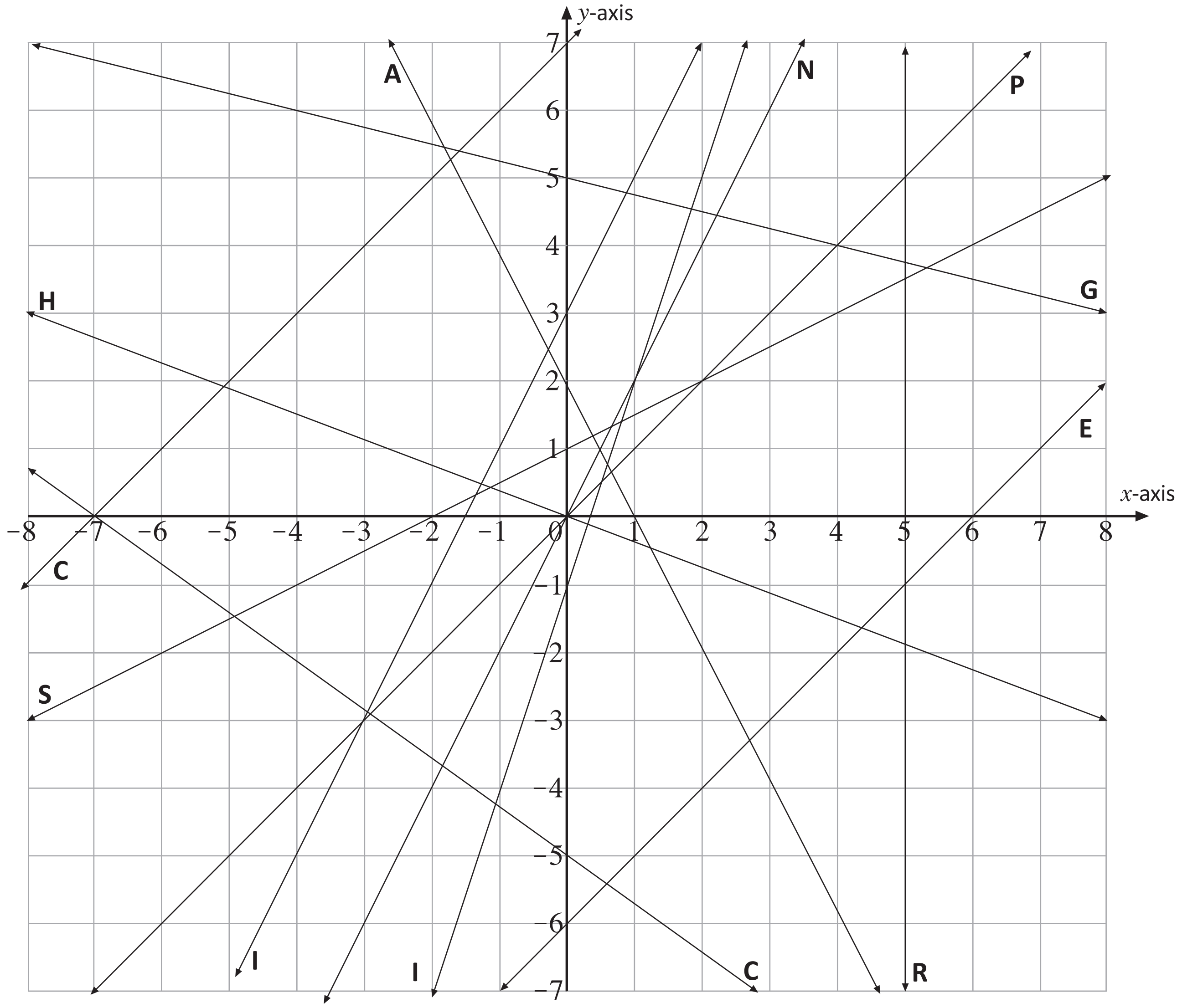

$y$-intercept $(b) = 0$

Gradient $(m) = \frac{-3}{+5} = -\frac{3}{5}$

$$y = mx + b$$
$$\therefore y = -\frac{3}{5}x$$

## The linear equation from the graph

Match the letter of each graph with its linear relationship.




$y = 2x$ $\quad$ $y = 3x - 1$ $\quad$ $y = 7 + x$ $\quad$ $y + 6 = x$

$4y = 20 - x$ $\quad$ $x = 5$ $\quad$ $\dfrac{y}{2} = 1 - x$ $\quad$ $y = x$ $\quad$ $3x + 8y = 0$ $\quad$ $y = 2x + 3$ $\quad$ $5x + 7y = -35$ $\quad$ $y = \dfrac{4x + 8}{8}$

## Comparing graphs

By graphing more than one linear equation onto the same set of axes, we can see if there is a special relationship between them.

Let's see what happens when two linear equations with the same gradient are plotted together.

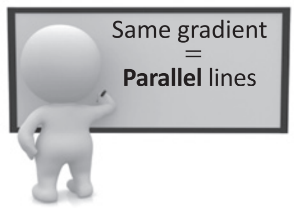
**Graph the linear equations $y = x + 1$ and $y = x - 3$ on the same set of axes**

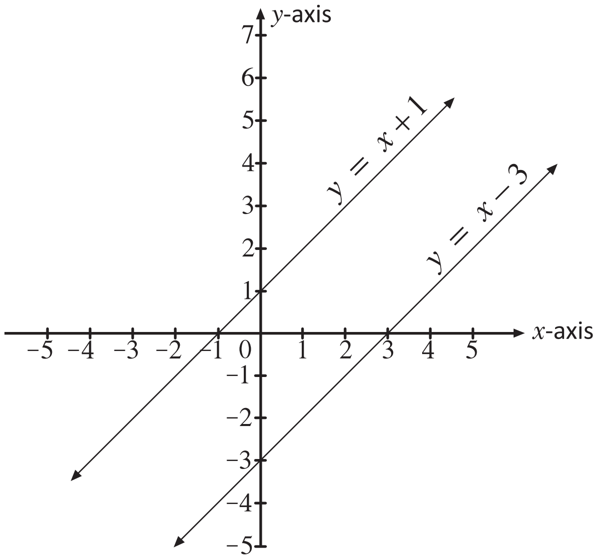
For: $y = x + 1$

$m = 1$ and $b = +1$

For: $y = x - 3$

$m = 1$ and $b = -3$




Parallel lines never cross each other

Let's see what happens when these three equations are graphed on the same set of axes.

**Graph these equations on the same set of axes: $= 2$, $y = \frac{1}{2}x + 1$ and $y = 4 - x$**

For: $y = 2$ (horizontal line)

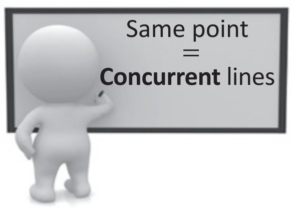
$m = 0$ and $b = +2$

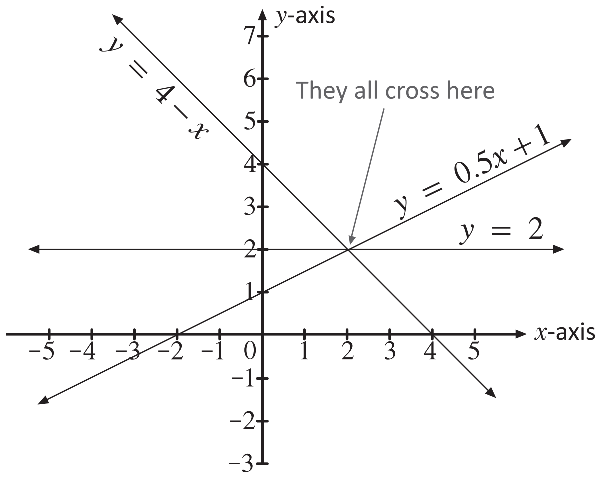
For: $y = \frac{1}{2}x + 1$

$m = \frac{1}{2}$ and $b = +1$

For: $y = 4 - x$

$m = -1$ and $b = +4$




All three graphs go through the same point: $(2, 2)$

$\therefore$ if you substitute $x = 2$ into any of these equations, $y$ will be $2$

## Comparing graphs

1. Compare the gradients for each of the following pairs of linear equations and tick whether they are **parallel** or **not parallel**.

Remember: Parallel lines have the same gradient

a. $y = 2x + 3$ and $y = 1 + 2x$

Parallel ☐ Not Parallel ☐

b. $x + y = 4$ and $y = x - 4$

Parallel ☐ Not Parallel ☐

c. $y = \frac{x}{3}$ and $y = 1 + \frac{1}{3}x$

Parallel ☐ Not Parallel ☐

d. $y - 2x = 2$ and $y = 2 - 2x$

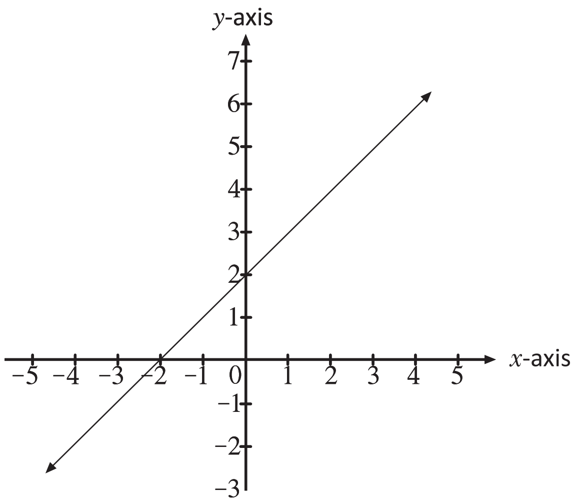
Parallel ☐ Not Parallel ☐

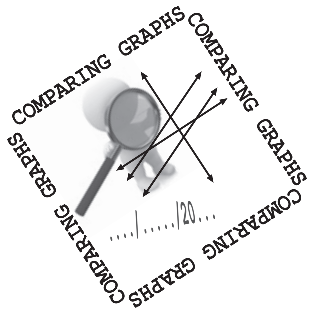
2. In each of these, one linear equation has already been graphed but not labelled. Compare the gradient of the graphed equation with the un-graphed equation. Tick whether they would be **parallel** or **not parallel** when graphed on the same set of axes.

psst!: You can graph the other equation if it helps!

a. $y = x + 4$

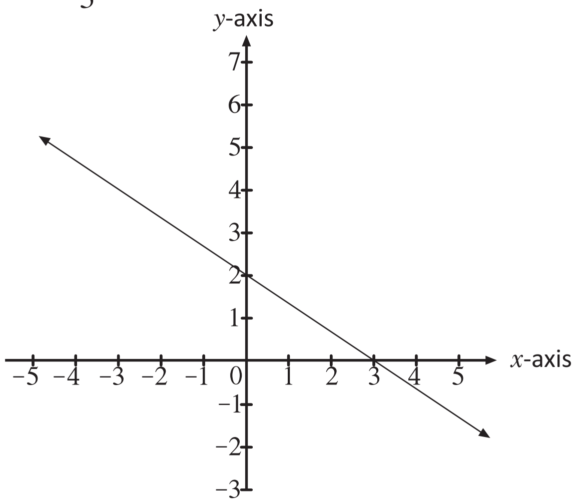
Parallel ☐ Not Parallel ☐



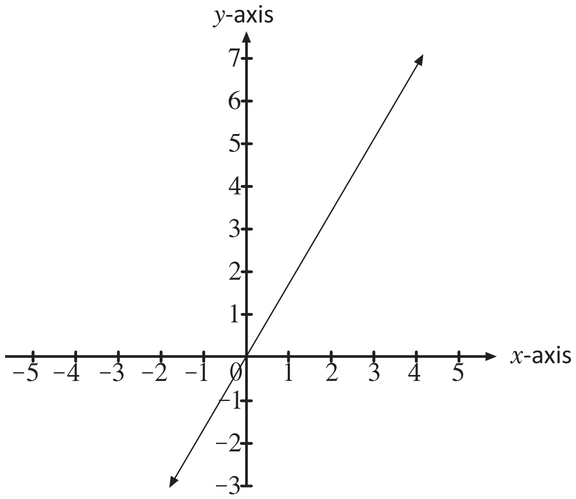
## Comparing graphs

**b** $y = \frac{2}{3}x - 2$



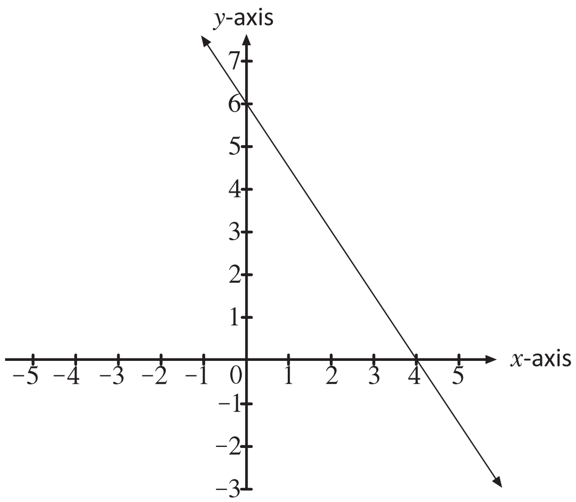

Parallel ☐ Not Parallel ☐

**c** $3y = 9x$




Parallel ☐ Not Parallel ☐

**d** $2y + 2 = -3x$




Parallel ☐ Not Parallel ☐

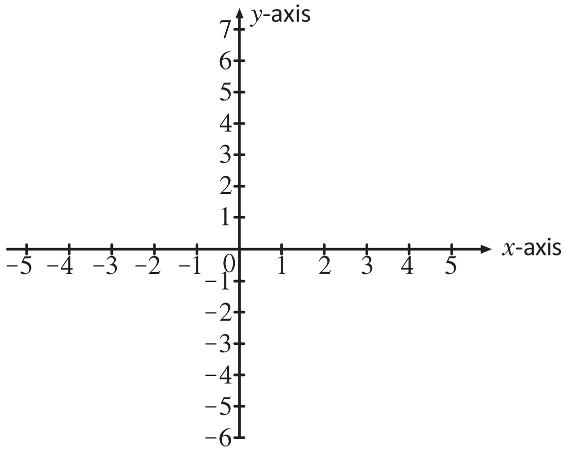
## Comparing graphs

**3** (i) Sketch each of the three linear equations on the same set of axes
(ii) Tick whether they would be **concurrent** or **not concurrent**

**a** $y = x\,,\, x = 4\,,\, 4 = 2x - 4$

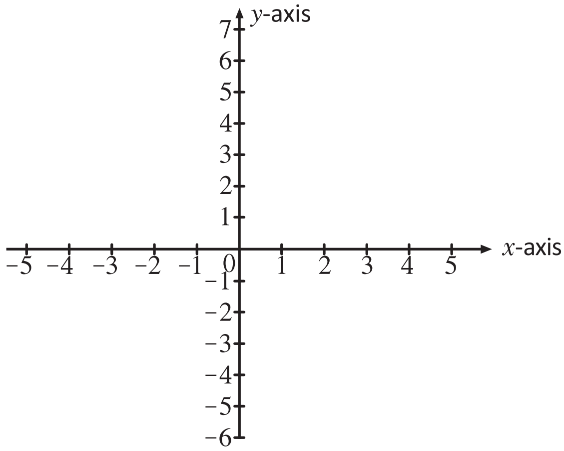
Concurrent ☐ Not Concurrent ☐

Remember:
Concurrent lines all pass through the same point



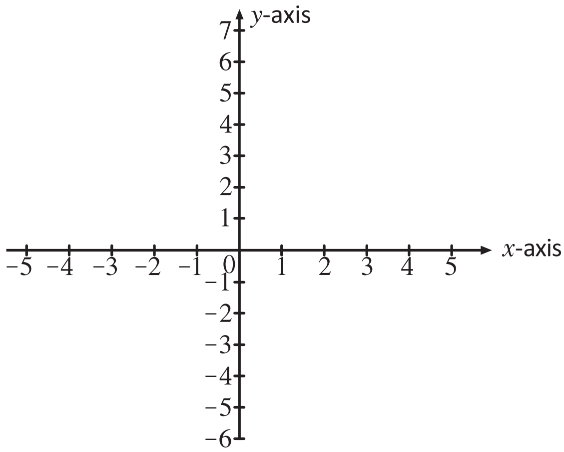

**b** $y = \frac{1}{2}x\,,\, y = 1\,,\, y = 1 - x$

Concurrent ☐ Not Concurrent ☐




**c** $3y + 6 = 6x\,,\, x = 2\,,\, 2y + 8 = 6x$

Concurrent ☐ Not Concurrent ☐



## Intersection of two linear graphs

Where the graphs of two linear relationships cross each other is called their **intersection point**.
At this point, the same $x$ and $y$ values work in both linear equations.

For the equations $y = 2x + 1$ and $y = 4 - x$

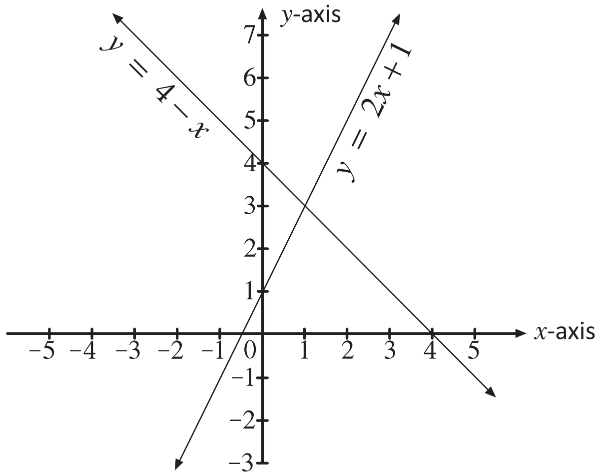
(i) Graph the lines $y = 2x + 1$ and $y = 4 - x$ on the same number plane

For: $y = 2x + 1$

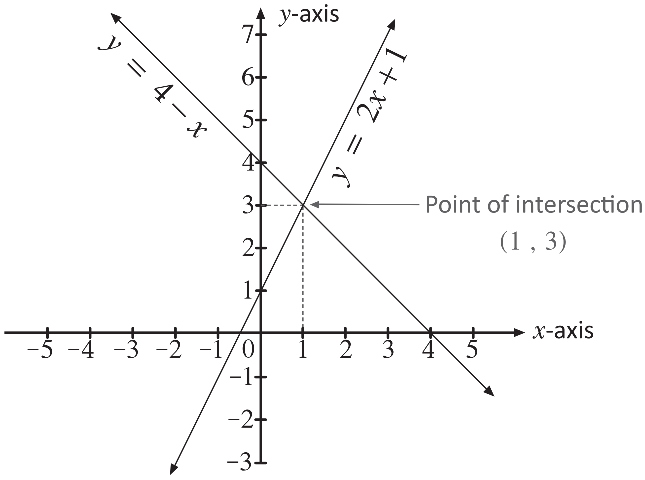
$m = 1$ and $b = +1$

For: $y = 4 - x$

$m = -1$ and $b = +4$




Draw vertical and horizontal lines from the intersection point to the axes to find the coordinates
(ii) Write down their point of intersection




The intersection of horizontal and vertical graphs is easily found by combining their equations.

Write down the point of intersection for the lines $x = 4$ and $y = 1$

$\therefore$ Point of intersection is simply: $(4 , 1)$

$x = 4$ $\quad$ $y = 1$

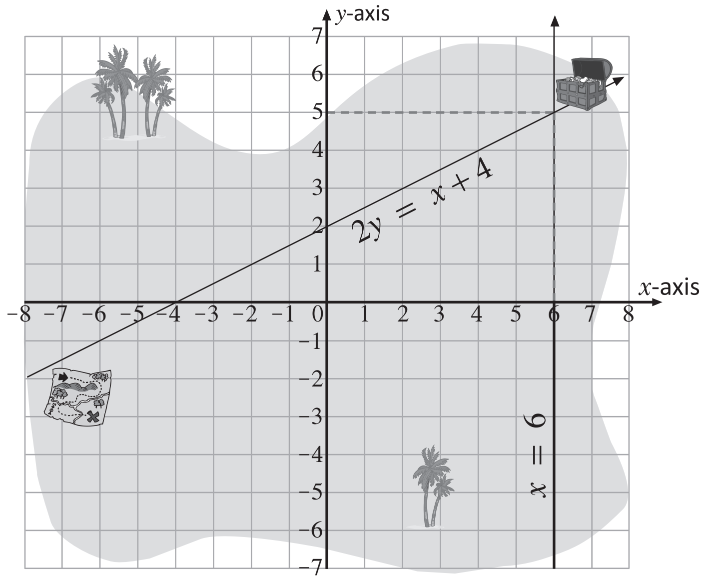
Here is a similar example in a different context.

Two treasure hunters are walking in straight lines toward hidden treasure along two different paths. Their paths cross at the exact location of the treasure.

(i) "One-eyed Pi" is walking along $2y = x + 4$

"Two-eyed Squinty" is walking along $x = 6$

Graph their paths to determine the location of the treasure




One-eyed Pi: $2y = x + 4$ Two-eyed Squinty: $x = 6$

$$\therefore \; y = \frac{x}{2} + 2$$

$$\therefore \; m = \frac{1}{2} \qquad b = 2$$

These graphs intersect each other at $(6\ ,\ 5)$

$\therefore$ the treasure is at coordinates $(6\ ,5)$

(ii) A third treasure hunter believes the treasure lies on the path $y = x - 3$. If he is walking from the third quadrant along this path, show whether he will not find the treasure or not.

Treasure is at $(6\ ,\ 5)$ substitute $x = 6$ into the equation

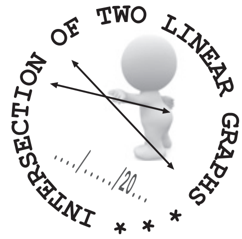
$\therefore$ when $x = 6, y = 6 - 3$

$= 3$

$\therefore$ when $x = 6$, he will be at coordinates $(6\ ,\ 3)$, $2$ units away from the treasure

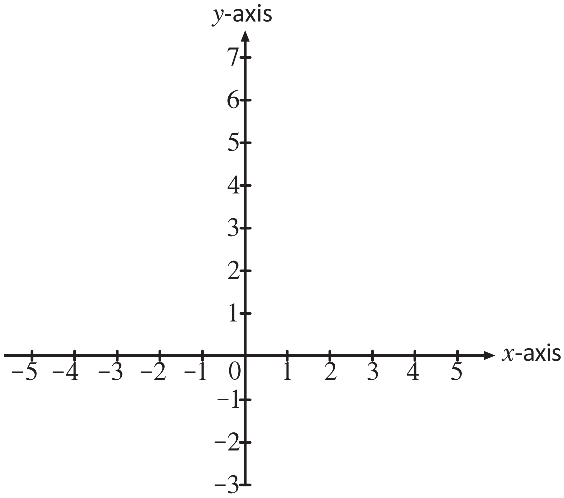
$\therefore$ he will not find the treasure on this path.

## Intersection of two linear graphs



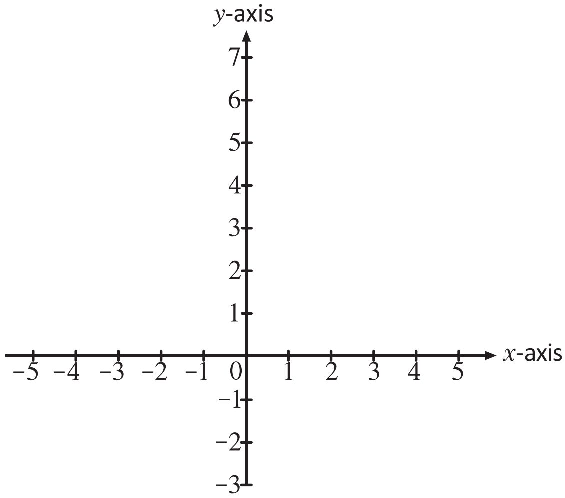

1. (i) Graph each pair of equations below on the same number plane
   (ii) Write the coordinates of their point of intersection

**a** $y = 3 - x$ and $y = 2x$



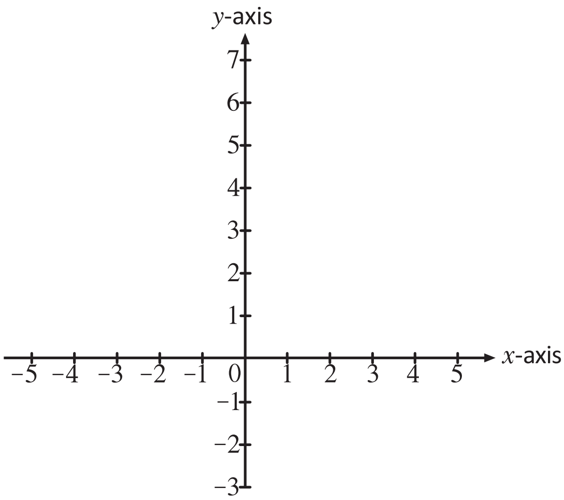

Point of intersection: (     ,     )

**b** $y = 2x - 2$ and $y = -x + 4$



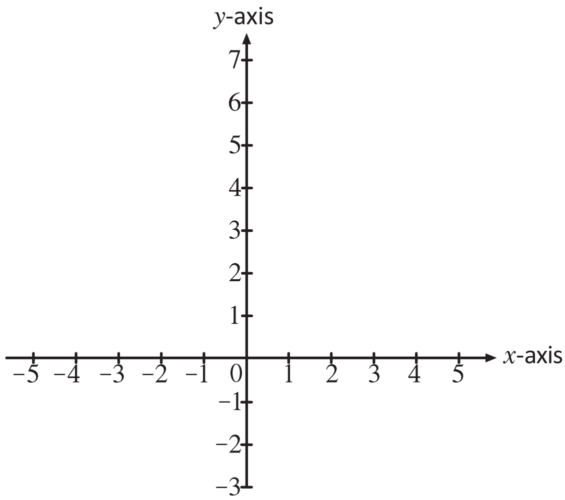

Point of intersection: (     ,     )

**c** $y = 3$ and $x = -1$




Point of intersection: (     ,     )

**d** $x = -3$ and $y = -2x - 1$

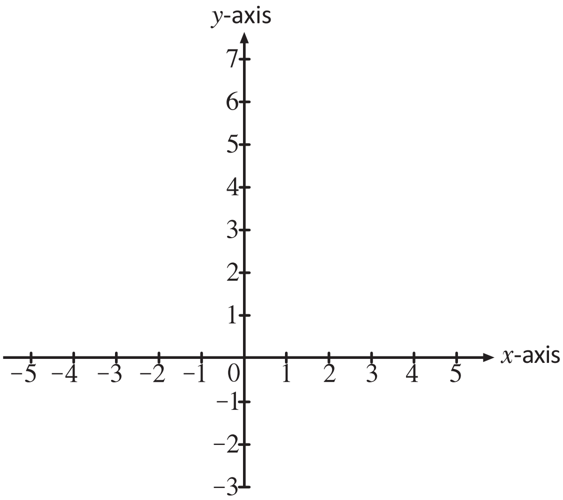



Point of intersection: (     ,     )

## Intersection of two linear graphs

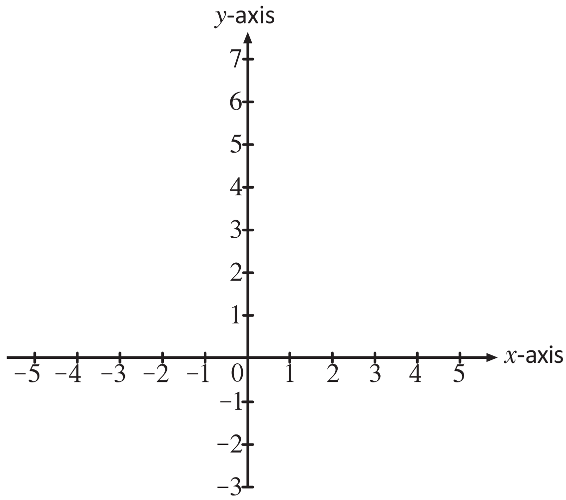
**2** (i) Graph each pair of equations below on the same number plane
(ii) Write the coordinates of their point of intersection

**a** $y = x + 2$ and $y = \frac{3}{5}x$



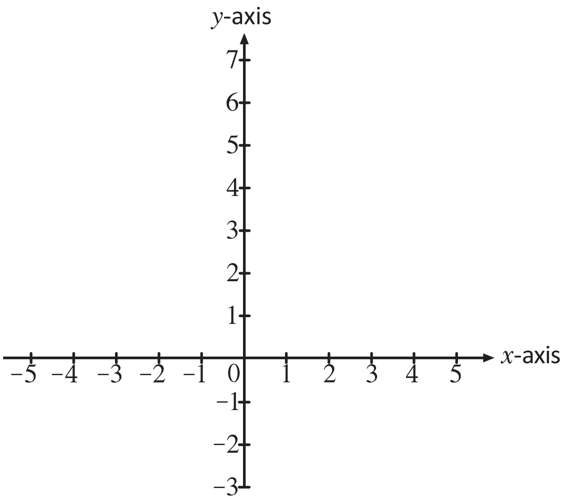

Point of intersection: (  ,  )

**b** $y = \frac{1}{2}x + 2$ and $y = \frac{3}{2}x + 6$



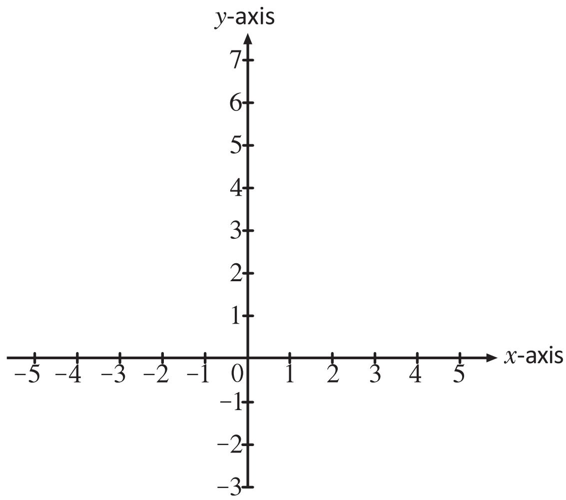

Point of intersection: (  ,  )

**c** $y = x - 2$ and $y = 4 - \frac{x}{2}$




Point of intersection: (  ,  )

**d** $y = -x$ and $4y = 12x + 16$



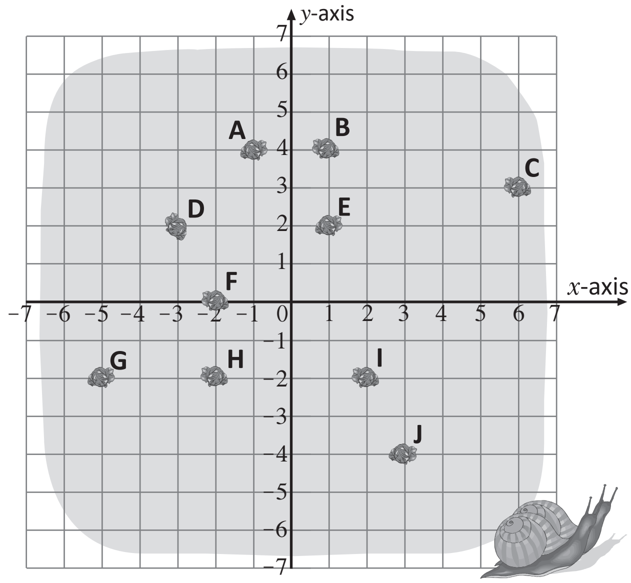

Point of intersection: (  ,  )

## Intersection of two linear graphs

**3** Two snails have spotted the best lettuce in the garden and are travelling in straight lines towards it.

Slidy Sam is following the path $y = 2 - 2x$

Slippery Shelly is following the path $2y = -x - 2$


(i) Graph the path of each snail.

(ii) Which lettuce are they moving towards if it is at the point where their paths cross?

Sam and Shelly are moving towards lettuce:

(iii) Sluggy Steve is also in the garden sliding towards a lettuce along the path $2y = 3x - 12$.
Show that Sluggy Steve is not moving towards the same lettuce as the two snails by graphing his path.
Which lettuce is Sluggy Steve moving towards?

Sluggy Steve is moving towards lettuce:

(iv) Write down the linear equations for two different paths that pass through the **centre** of three lettuces.
hint: find the possible paths first using a ruler

First path passing through the centre of three lettuces:

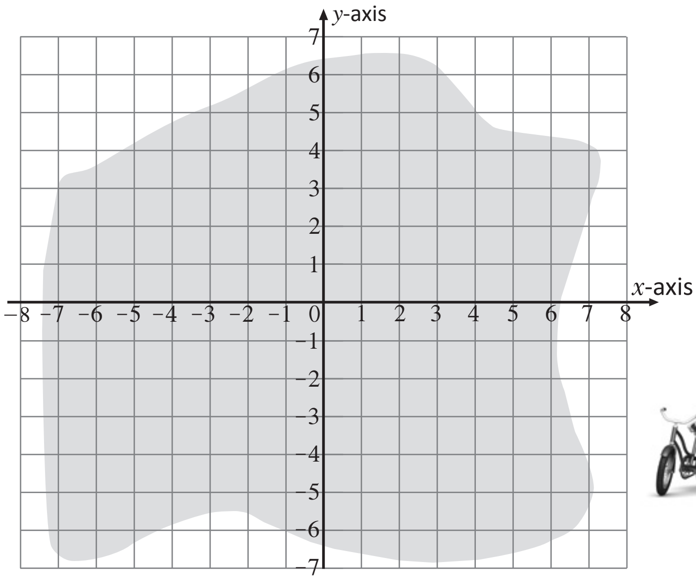
Second path passing through the centre of three lettuces:

## Intersection of two linear graphs

**4** Dani and Reece both rode their bicycles through a park twice at different times of the day.

Dani rode along the following paths: $y = 2 - 6x$ and $y + x = -3$

Reece rode along the following paths: $6y = 12 - x$ and $3y = 9x - 21$




(i) Graph the path of each ride through the park.

(ii) How many times did Dani's riding paths cross with Reece's within the park?

Dani and Reece crossed paths ______ times within the park.

(iii) Write down all the coordinates where Dani's paths crossed with Reece's.

(iv) Write two equations for different paths through the park that **only** cross through **one** of Reece's paths.

First path through: ______

Second path through: ______

## Reflection Time

Reflecting on the work covered within this booklet:

1. What useful skills have you gained by learning about linear relationships?

2. Write about one or two ways you think you could apply linear relationships to a real life situation.

3. If you discovered or learnt about any shortcuts to help with linear relationships or some other cool facts, jot them down here:

**Here is a summary of the important things to remember for linear relationships**

### Gradient-intercept form

the power of $x$ and $y$ is always $1$

gradient-intercept form $\longrightarrow$ $\boldsymbol{y = mx + b}$

coefficient of $x$ $(m)$ is the gradient

the constant term $(b)$ is the $y$-intercept

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### Graphing using the intercept and gradient

After first plotting the $y$-intercept, the gradient can then be used to find a second point to help draw the graph.

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### The linear equation from the graph

By working in reverse to before, you can find the $y$-intercept and determine the gradient of the line. These values are then substituted into the gradient-intercept formula.

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### Comparing graphs

- Graphs with the same gradient are parallel to each other (they never cross)
- If a number of graphs pass through the same point, these graphs are called **concurrent** graphs

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### Intersection of two linear graphs

Where the graphs of two linear relationships cross each other is called their **intersection point**.
At this point, the same $x$ and $y$ values work in both linear equations.

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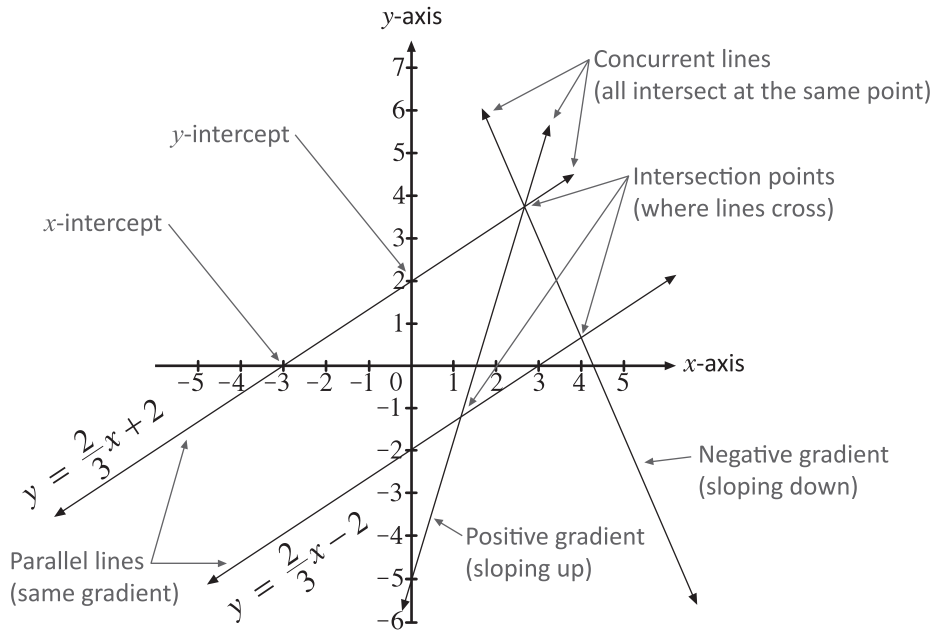
### Picture Summary



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